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Edited by

ROLAND V. NORRIS, D. Sc., F.I.C.,
Director, Tea Research Institute.

THE TEA RESEARCH INSTITUTE,
St. Coombs, Talawakelle.

H. W. CAVE & CO., COLOMBO.

The Tea Research Institute of Ceylon.

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	...	F. D. Tillekeratne

Superintendent, St. Coombs Estate ... J. A. Rogers

NOTE.

The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address:—Research, Talawakelle; Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

EDITORIAL

FOOD PRODUCTION

Before long fairly detailed reports should be available indicating the results obtained by estates on food production work during the South West season.

As was clearly indicated in the first circular issued in connection with food production on tea estates (Department of Agriculture, Leaflet No. 192 (Food Production Leaflet No. 13), little information was available in regard to the growing of food crops at the higher elevations and none at all in regard to the interplanting of such crops in pruned tea. Work had to be commenced therefore under difficult circumstances and it has been a further misfortune that these initial trials have had to be made in the South West season, *i.e.*, so far as most districts are concerned, under the most unfavourable climatic conditions. To add to these handicaps, artificial manures have been available in limited quantities only to up-country estates and while in some cases it has been possible to meet this deficiency to some extent by the use of compost, the general lack of fertilisers has had an important bearing on the results so far obtained.

In all these circumstances it is not, perhaps, surprising that, speaking generally, very disappointing results have been obtained. Later in this issue will be found a very brief and preliminary report on the areas which fall under the supervision of the Tea Research Institute. This report is necessarily very incomplete and based on few actual crop returns which will not be available until the forms shortly to be issued to estates are received and analysed.

In the dry zones little time was available for sowing, in consequence of which the land to be used was often inadequately prepared and sowings were frequently too late. June and July were particularly dry months and very high winds were experienced which caused much damage.

In the wet zones on the other hand it is probable that sowings were in many cases too early with the result that crops came to the flowering stage in excessively wet weather and little or no grain was set. In many cases, however, particularly with cowpea, excessive rains led to conditions favouring disease and the crops were stunted from the beginning and made little growth.

Root crops, such as manioc and sweet potato, as might be expected have generally speaking been much more successful in all areas and though few, if any, yield data are yet available substantial crops should be obtained.

Another fact which emerges is that, with a few exceptions, cultivation of patna land has given most indifferent results. It does not seem possible to bring such land, in one season at any rate, into the condition of cultivation and tilth required for most food crops.

The above results are disappointing but it is clear that the main reason for comparative failure in the wet zone has been climatic conditions. It seems evident that in these areas during the South West monsoon conditions are too severe to expect success with crops other than roots and some vegetables. On the other hand the

prospects are much more favourable for North East sowings and there seems to the writer no reason, so far as growth conditions are concerned, why successful results should not be obtained then, provided times of sowings are carefully arranged so that the crops can mature and ripen under suitable conditions of climate.

Other difficulties such as theft and depredation by birds, bandicoots, monkeys and other pests will unfortunately still remain to be overcome.

When all this has been said there still remains the major question as to the correct policy that should be adopted to produce the large quantities of foodstuffs that are undoubtedly required. Where estates are favourably situated and have suitable land available there can be no question such land should be utilised as fully as possible for the production of food. In other cases, and up-country these probably form the majority, it would, as has repeatedly been stressed, seem preferable and altogether a better economic proposition to develop land at more suitable elevations, and if possible with irrigation facilities, where food production can be of a more intensive nature. There is probably fairly general agreement on this point but, so far, with no surplus of estate labour no solution has been found to the labour problem involved. Moreover the regulations in the Food Production Ordinance relative to the formation and operation of syndicates for food production schemes are by no means free from ambiguity and it has so far proved difficult for estates to ascertain with any certainty what their contingent liabilities under such schemes may be. It is most desirable that these uncertainties should be cleared up at the earliest possible date. Otherwise there seems little prospect of such syndicates being formed on any wide scale and estates, in order to satisfy their other obligation under the Ordinance, will be left with no option but to attempt food production on their own land, under conditions which in many cases offer little prospect not only of economic success but of producing food in any appreciable quantities.

It is clear that the whole question will have to be reviewed in the near future and the time for this would seem to be when reliable returns are received from estates as to the actual results obtained. Forms for this purpose are shortly to be issued to estates and an appeal is made to all those responsible to complete these forms as accurately and speedily as possible.

Food Production Committees have been formed in practically all planting districts and they can do much to assist by collecting all such information as may be available in their respective areas in regard to food production. It is only on the basis of such information that it may be possible to make suggestions for the amendment or modification of the Food Production Ordinance.

It is hoped such Committees will also maintain close contact with the Research Institute to which their areas are allocated. The research officers are only too anxious to co-operate with them in every possible way, to attend meetings of the Committees, and to visit estates in each district to give such advice and assistance to Superintendents as may be in their power.

The above notes may appear a rather gloomy summary of the present position but as has already been pointed out there is every reason to expect materially better results in the coming season.

However sceptical individual persons may be as to this, the basic fact remains that food is urgently required and in the largest possible amount. There are many

who are unduly complacent on this point and appear to think that India can be relied on to solve our difficulties in the matter. While there is not the slightest reason to doubt the good-will of India in this matter and their desire to help to the utmost of their power, it has to be realised that, apart from transport difficulties, India has its own food problems and in this connection the attention of readers is invited to a reprint in this number of a talk by Dr. Aykroyd, the Director of the Nutrition Research Laboratories in Coonoor.

The obligation therefore remains on all concerned — and incidentally not the planting industries only — to contribute what they can to the production of food in Ceylon. The problem is one of more than immediate importance and considering the matter from the point of view of estates only there can be little doubt it would be in their own interests to make their labour permanently more self-supporting in the way of food requirements. If it does nothing else the successful production of an increasing variety of food crops in the Island by broadening the present range of diets would contribute materially to the health of the population generally.

MANURE

The majority of estates, and particularly those up-country, have experienced considerable difficulty in obtaining supplies of manure, this being due not to any particular shortage of fertilisers in Ceylon but rather to internal transport difficulties.

At a time when the maximum production of tea is required and estates are also being called on to grow food this shortage is particularly serious. It is understood a Committee of the Planters' Association is investigating the question and that schemes are under consideration whereby reasonable amounts of manure may be railed to a limited number of centres from which distribution to estates will have to be organised locally.

It seems unlikely that estates will receive anything approaching their normal requirements but this fact makes it the more imperative that distribution should be organised at the earliest possible moment so that, at any rate, available supplies may be divided in a manner fair to all concerned.

SEED SUPPLIES

The following extract from Food Production News Sheet No. 3 is reprinted for the information of all concerned.

"*Seeds.*—Steps should be taken now to make provision for next year's planting material. It is not proposed that the emergency seed store at Peradeniya shall be continued indefinitely and, whenever possible, seed should be reserved from the current season's harvest for future sowing. Care in the selection and storage of this seed will be amply repaid. With crops like cowpea, green gram and kurakkan it is suggested that, immediately before the general harvesting, seed for the next season should be selected from the most prolific plants, not necessarily in the more fertile parts of the area. With maize, the best cobs can be selected after harvest and retained for seed.

"The cobs of maize and the ears of kurakkan and cumbu so selected should not be threshed immediately. They should be thoroughly dried and stored carefully, and the seed removed shortly before sowing. All seed reserved for sowing must be very thoroughly dried. Suitable methods of storing are suggested in the Food Production Leaflets. It may be as well to repeat the warning given in the last News Sheet that artificial drying at high temperatures is fatal to seed.

"It is possible that acclimatization will play a large part in the productivity of seed. Other things being equal, your own seed or seed from crops grown by your neighbour under climatic conditions similar to your own is likely to be more productive than seed procured from outside sources. Superintendents who have not sufficient seed for next season's planting and who cannot easily obtain supplies from their neighbours are requested to place their orders with the Food Production Officer (Seeds), Peradeniya, as soon as possible. The approximate date by which the seed will be required should be stated."

ROLAND V. NORRIS.

FOOD PRODUCTION ON ESTATES*

PRELIMINARY REPORT

ROLAND V. NORRIS

The areas allotted to the Tea Research Institute have been distributed, for purposes of supervision, as follows :—

Uva Balangoda	Director.
Dimbula Dickoya Dolosbage and Kotmale	Dr. Eden.
Nuwara Eliya Pussellawa	Dr. Bond
Statistics generally —	Dr. Gadd.

The information so far available is of a rather general and incomplete nature and the issue of the contemplated Food Production Returns is urgently required if anything like a complete picture is to be obtained.

ST. COOMBS

On St. Coombs, root crops, *e.g.*, manioc and sweet potatoes, have been planted up in various areas. Both of these crops seem to do well but they are not yet mature and no yield figures are yet available. Yams have also been planted in a small block (laboratory compound). These have grown well, particularly *Colocasias,* but are not yet mature.

Trials of other crops — Maize, Cumbu, Cowpea, Sorghum — have been made in pruned areas of mature tea and/or in young tea clearings (1938).

The difference between these two areas is striking. In the young clearings, where perhaps better results might have been expected, the crops are stunted and have made little growth and the experiment must be considered a failure. Artificial manures have not been available and this no doubt partly accounts for the unfavourable result, but the main reason is probably the ques-

* This report refers only to the areas mentioned above which are allocated to the Tea Research Institute for supervision.

ion of cultivation. This land before planting in tea was patna and it is clear that in he few years that have elapsed since opening, the amount of cultivation and green nanuring has been insufficient to bring the and into the state of fertility which exists n mature tea areas which have for a much onger period received normal cultivation nd manures (artificials and green nanures).

In the pruned areas of mature tea, Cumbu and Maize both initially grew easonably well ; Cowpea must be considered a failure, the main cause being no oubt excessive rain leading to disease. It as also been heavily attacked by eelworms. 'ery little crop will however be obtained rom the Cumbu as heavy rain at the time f flowering has prevented setting of grain. 'he yield from the Maize is also likely to e very moderate as the number of cobs is nall.

Rainfall Figures

	Inches	Wet days
April ...	7.83	21
May ...	6.57	14
June ...	15.15	27
July ...	22.22	26

IMBULA, DICKOYA DOLOSBAGE-KOTMALE

Preliminary results from estates confirm generally the impression gained at . Coombs and indicate that for the wet ason root crops are the only ones likely to give results. (Groundnut is perhaps worthy of trial). They also confirm the opinion previously expressed by the Institute in regard to the unsuitability of the local patnas for food production.

The general inference from the above, subject to final results, is that in the wet areas most of the crops tried, except roots, are not likely to give material results in the Yala season though better results are likely to be obtained in the North East. In any season the availability of manures is likely to have a determining influence and tilth is obviously also of importance.

UVA

The data so far available refers chiefly to the Bandarawela-Haputale side, reports from the Badulla area being few in number to date. Though a few individual estates have had some success, the general result may be summed up in the following report received recently from the Chairman of the Bandarawela-Haputale Food Committee : "There is no doubt that most experiments have been complete failures or very disappointing for the past season. A few of us, like myself and Macaldeniya, who are more favourably situated, have been fairly successful with some crops. There is very little doubt in my mind that, except for, possibly, vegetables and dairy cattle, Haputale is not a suitable district for food production."

The weather has of course been unfavourable owing to severe drought in June and July. The manure question, here as elsewhere, has also had a marked influence on results.

With regard to individual crops, the following provisional comments are made : One estate which has generally speaking been the most successful gives the following yields obtained in jungle clearings :—

Meneri	...	11½-12 bushels per acre	
Kurakkan	...	8 -12 „ „ „	
Cumbu	...	16 „ „ „	(Interplanted in tea 3 bushels per acre)
Maize	...	19 „ „ „	
Kollu	...	4 „ „ „	

Generally, however, results have been far less successful.

Kollu has been fairly widely grown and seems one of the most promising for the dry season in Uva as it does not require a particularly fertile soil.

Dwarf Bean (Gas bonchi) which at one time looked promising has proved disappointing. Severe damage has been caused by "Cutworms."

Cumbu has given promising results on several estates but is badly attacked by birds. Heads are smaller than normal, possibly due to the variety of seed.

Sorghum started well but has generally failed to mature.

Maize has done well on estates where rainfall has been favourable.

Kurakkan.—Similar results to Maize.

Of minor grains Meneri seems to have done best. Complaints are wide-spread of damage by pests, *e.g.*, rats, squirrels, monkeys, etc.

Root Crops have been fairly widely tried. A crop of 700 lb. per acre of sweet potatoes is reported from one estate.

I am indebted to Mr. Harbord, the Agricultural Officer, E.D., for his co-operation in obtaining information about results in his area.

BALANGODA AREA

The results generally are similar to those in the Haputale area.

Much damage has been caused to food crops by excessive winds.

NUWARA ELIYA

Horse Gram and Cowpea have done better than other crops but the yield even from the best of these trials is unlikely to be very satisactory.

At the higher elevation it is proving very difficult to find crops that will grow at all well. One estate in Kandapola reports that even Sweet Potato was a failure. It has been suggested an experimental plot might be opened at Nuwara Eliya or Kandapola to try out different varieties.

PUSSELLAWA

All estates are reported to be co-operating and progress has been made. In the present season root crops have been the basis of work on most estates and these are believed to be doing well. On certain estates deniyas are being converted into paddy land and groundnuts have been successfully grown.

On a Government experimental area at New Peacock, Kurakkan was unsuccessful and Cowpea has now been planted.

GENERAL

There is a general impression in the areas under discussion that food production on tea estates is most unlikely to yield results in any way comparable with the labour and expenditure involved.

The opinion is widely held that food will be produced in the required amounts only by the utilisation of land outside estates where conditions of elevation and climate are more suitable.

The effort to promote such cultivation by means of syndicates has however not made material progress, largely due to uncertainties which still prevail as to the legal and financial obligations of estates combining to form such syndicates. It would seem most desirable that a clear statement should be issued by Government at the earliest possible date defining such obligations.

A NOTE ON IRREGULARITY IN MANURING

T. EDEN

With the prevailing uncertainty in delivery of manures some general direction on how to modify manurial schedules becomes desirable. The following short note indicates how this can be done whilst still maintaining some logical sequence in applications.

Attention is here restricted to programmes which follow clearly the general recommendations of the Tea Research Institute, *i.e.*, the use of some standard mixture in graded quantities throughout the pruning cycle, commencing not earlier than the time of tipping. Where 'special' mixtures designed as 'pruning' and 'general' are still in use, no rational alteration can be made short of abandoning the whole system.

The chief question that short or delayed delivery will raise is on what fields, and particularly at what stage in the pruning cycle can available supplies best be concentrated. There may be a natural desire to keep schedules as unaltered as possible and this would lead to the use of manure at hand on a field or fields just starting their new cycle. If a field in bearing has already got out of step with its programme why not accept the inevitable on that field and keep the newly pruned fields straight if possible? This orderly procedure is not to be recommended for the main consideration at present is crop and the adequate use of such manures as are obtainable to maintain that crop. Experiments have shown that of all the applications of manure the earliest is the least efficient. Consequently, if necessary, it is advisable to sacrifice manure for first-year fields.

The second decision that will have to be taken is what to do with fields that have passed their normal dates. Should they receive their normal dose regardless of the date; should they, if the manure is applied late, receive the normal dose at the subsequent manuring; or should a compromise be made by amalgamating two applications at any rate as far as date is concerned? A concrete illustration will show how the third proposition can be carried out.

A typical manuring programme for a 4-year cycle would be as follows :—

Application	Months from pruning	lb.	N. lb.	Proportional N. per mensem
1	6	500	29.4	3.3
2	15	667	39.2	4.4
3	24	750	44.1	4.9
4	33	833	49.0	5.4
5	42	583	34.3	5.7

Let us suppose that the second application has had to be delayed owing to non-delivery and that the stage of the cycle reached is 20 months after pruning. Then since four months, out of the nine months' interval between applications remain before the third manuring, the 2nd and 3rd can be amalgamated by applying

$$\frac{(4 \times 667) + 750}{9} = 296 + 750 = 1{,}046 \text{ lbs.}$$

In this way no account is taken, so to speak, of the lost five months. There is no point in manuring for crop that has already been harvested. It is not of course correct to regard manure as being taken up at an even monthly rate but this method preserves a sense of proportion in the doses.

Since we are supposing that the 2nd dose is delayed, then obviously for the field in question the manure delivered will only amount to 667 lb. per acre instead of the 1,046 required for this combined operation. It is at this point that the choice between using fertilisers for first or later doses becomes operative. The revised quantity may have to be made up from consignments due for other fields according to the regular programme. As indicated previously, the better choice is to use the appropriate quantity on later doses, taking care, however, not to overdose the field in the last six months.

WHAT IS A GOOD SOIL*

T. EDEN

My part in these Food Production broadcasts is to talk to you for a few minutes about the part the soil plays in growing the crops, and to explain very briefly why some soils are good and others are bad ; how good soils can be kept good and poor soils can be improved.

But first of all what is soil ? If you went into York Street and pulled up a paving stone on the footpath and smashed it up into pieces so small that it would blow about like dust would that be soil ? Or

* A talk broadcast from the Colombo Studio on May 24, 1942.

if you went onto the shore and chose the cleanest of sand could that be accurately described as soil? The answer to these two questions is emphatically No, because, although the particles might be just about as small as those of the earth in your garden, or on your estate or small-holding, they would lack a certain quality of stickiness which soil possesses, and which it gets from two sources; first from the decayed remains of plants and animals, and second from the chemical action of water in which some of those products of decay are dissolved. This stickiness, properly controlled, is a most important property as I shall try and show you later, and it is those ingredients in a soil which the soil scientist calls colloids, (a word which really means 'like glue.' but sounds more mysterious because it has a Greek origin), that are the most important ingredients.

The decayed and decaying vegetable and animal remains in soil are referred to agriculturally as humus, and it needs no emphasis to make it plain that the soils which are likely to be the richest, other things being equal, are those whose surface layer is most richly provided with humus, in particular from forest and luxuriant grass land. It is fatally easy, however, to place too much reliance on the apparent luxuriance of the vegetation that grows on the land, especially in tropical climes. Nature is never so economical with her goods, never so to speak so good a housekeeper as she is in forest land, but she is slow, and it takes hundreds and thousands of years to lay down that fertility which we associate with the humus of virgin land. When we bring such land under production, we require that our crops should grow at an altogether different speed from that of the forest. The minute we fell a jungle or break up a grass land we speed up the release of plant foods in the soil by the mere letting in of sun and air, and by breaking up the surface we accelerate still further those processes which Nature has hitherto managed with such care. That is the price we have to pay for the prospect of quick-growing crops and high yields, but unless our preparations are done with care it may turn out to be a bitter price in soil impoverishment and, in this country, soil erosion.

That brings me to the first point I wish to make in relation to soils and food production, that no cultivator worthy of the name should be content to exploit the accumulated fertility of virgin soil. If he does, he will soon face, in greater or lesser measure, conditions similar to the dust bowls of America, the barren acres of Australia, or the scarred gullies of far too much of our Ceylon hill country. Wherever steady productive agriculture is carried on, in England in the west, in China in the east, the fertility of the land is in a real sense man-made, and rich soil reserves are constantly being re-created by sound agricultural practice. Only so can we think of fertility in terms not of two or ten seasons but of hundreds of years. True, our minds are at present concentrated on what we can do in the next few years, but let us not ruin the land permanently in the meantime.

In certain respects a fertile soil is like a fertile mind: it must be ALIVE: it must be WELL CULTIVATED: it must NOT BE SOUR. Let me explain these three points and show how they fit in with one another, and with the production of food The mixture of mineral and dead vegetable particles which I have already called soil. ever before any crop is grown in it is the home of a vast population of living plants in the form of fungi, which we meet frequently in everyday life as moulds and toadstools, and of bacteria with which ordinarily we have hardly a nodding

acquaintance because they are too small to see. If you put some soil in a glass tumbler mixed with a few teaspoonful of tea dust and keep it just moist enough to be able to turn it out in its shape without breaking it, you will see in a matter of five or six days a gossamer film of fungus between the soil and the glass. It was there all the time, but having given it some tea to feed on, it has rapidly grown and made itself visible. The bacteria you will not see, and you will have to take my word for it that if you made a little heap of fertile soil on a one-cent piece there would be at the very least two thousand million bacteria in that heap. These two kinds of minute organisms each in their proper place break down the raw plant remains in the soil and on the soil, prevent the soil from getting cluttered up with such debris, turn it into the humus and 'glue' of which I spoke earlier, and in the process release food for the growing plant in the form it best likes. This they do minute by minute year in and year out. The medical world has popularised bacteria as nasty things that make us ill. Well, some of them do, but others are wholly beneficent and our food, health and life depend on them. Of course these bacteria and fungi are neither entirely nor consciously philanthropists: they use these vegetable remains as their own food. So in order that a soil shall be alive it must be fed with vegetable remains in one form or another. That is why it is important not to exploit the original fertility to exhaustion Compost, cattle manure and green manure are the appropriate food for micro-organisms and your food production should be based on using any or all of these to capacity.

The tale of the good that soil bacteria do is only half told when we have considered how they contribute to the larder on which the food crop will draw. The roots of the plants need air and water and not too much of either, and a good soil is one which, when the weather is dry, will retain enough moisture to tide the plant over till the coming rain. Similarly, first-rate soils allow surplus water to drain to lower depths to underground reserves and never become water-logged. Now the secret of such versatility lies largely in the size of the soil particles and in the way they are grouped together. A soil that is all small particles or all large ones is not a good soil. It either holds water too firmly in the pores between the particles because they are too small, or not firmly enough because they are too large. A judicious mixture is best, formed into crumbs in which large and small lie cheek by jowl. And when it rains, as only our tropical skies know how to rain, it is imperative that the fine particles shall not wash down and silt up the crevices. That is where the glue, the colloid, comes in. It holds the water like a sponge in dry weather, it keeps the soil crumbs intact, open and well drained in the rainy season and, equally important, thus prevents the surplus rain from merely running over the surface causing soil wash and erosion.

To preserve this wholly desirable state of affairs a soil must be well disciplined or cultivated. The plant remains have to be well mixed with the soil so that the colloid humus coats every particle. Humus is not indestructible, and cultivation ensures that new and suitable combinations of particles are formed into crumbs from time to time, and that sufficient crevices exist for young and exceedingly delicate roots to penetrate and ramify in the soil without being damaged. A soil can be over-cultivated, or cultivated in unsuitable conditions, as for instance when it is too wet or too dry. But the margin of safety that lies between these two extremes is greatly increased by the presence of adequate supplies of organic

matter broken down by the living population of the soil.

The water held in the pores of the soil is never pure water ; it is not even of quite the same composition as the raindrops. As the humus in the soil is slowly dissipated, burned up by contact with the air which occupies roughly one half of the volume of what looks like solid earth, part of it is changed into carbon dioxide. Dissolved in the soil water this produces a weak acid, carbonic acid, which dissolves the valuable mineral foodstuffs more readily than would pure water. From this very weak solution the plant absorbs its mineral food, but as it is the mineral elements in the soil that keep it sweet, in time even a good soil will lose its sweetness and become sour. At this stage poisonous substances begin to dissolve which the delicate roots of most plants cannot tolerate and the crops begin to fail on such soils. The sovereign remedy for this is lime which checks the acidity and restores sweetness to sour land.

In order to tell you how the soil behaves I have taken it to pieces so to speak, and perforce I have spoken of the nutrients it contains, the bacteria, the colloids and the mineral particles as if they all played separate parts. In reality all the aspects I have been speaking of dovetail into one another like the pieces of a jig-saw puzzle. Lime for instance helps the bacteria and fungi to break down the raw vegetable matter ; so does the air that permeates the soil when it is properly cultivated. Again, these micro-organisms would cease to function if sufficient moisture were not present. But it is by the work of these same bacteria and fungi that the balance of air, water and food is so happily maintained. That is why the answer to the question, What is a good soil is "Soil that is alive, that is well cultivated and is sweet."

THE EFFECT OF PLUCKING ON SHOT-HOLE BORER ATTACK IN TEA

C. H. GADD

In 1939 an experiment was designed to test the planting opinion that hard plucking induces a heavier infestation by Shothole borer (*Xyleborus fornicatus* Eichhoff, *fornicatior* Eggers) in tea than does light plucking.[4] Six plots, each consisting of 10 rows of 20 bushes (approximately one-fifteenth of an acre) on Gonakelle Estate, Passara (elevation 3,500 feet) were used. All the bushes had been pruned alike in November/December, 1938, and all plots received similar cultural treatments except for the type of plucking. Three plots were plucked normally, here termed "light," while the other three plots were subjected to a more severe form of plucking, here termed "hard." In the light plucked plots plucking was restricted to the plucking table, and the plucked shoots consisted of a bud and two leaves, one full leaf above the fish leaf being left on the bush. In the hard plucked plots everything above the

fish leaf was taken from all branches, no matter whether they occurred above or below the plucking table.

Such hard plucking is not entirely unknown in planting history. The object of using it in this experiment was to determine whether severity of plucking had any effect on the degree to which bushes become attacked by borer.

Plucking was started on 12th May, 1939 and continued till 29th September, 1941. Until the end of March, 1940 the plots were plucked regularly at 7-day intervals, but after that date the pluckings were arranged to synchronise with the estate pluckings in the remainder of the field outside the experimental block. In all, the bushes were plucked on 106 occasions, 47 at weekly intervals and 59 at more irregular intervals over a period of 78 weeks.

The examination of bushes for shot-hole borer attack was started on February 7th, 1940 when the bushes were 14 months from pruning, and was continued until November 29th, 1940; 15 examinations being made at 3-week intervals. In each plot were a few undersized bushes, probably replacements, and these were avoided at all examinations. The normal-sized bushes were numbered, and for each examination 10 numbers were selected at random for each plot. The bushes bearing these numbers were clean pruned, the new cuts being made about 4 inches above the previous cut, and all prunings were removed to the laboratory for examination. Thus at each examination 30 hard plucked and 30 light plucked bushes were pruned. The method of examination of the prunings has been described in a previous article.[3]

More bushes were examined towards the end of the experiment, during the period October 9th to December 3rd, 1941; five examinations in all were made at fortnightly intervals. The size of the samples at these examinations varied somewhat and was never so large as at the earlier examinations, because the number of bushes available was insufficient. The number of bushes examined on each occasion is given in Tables 1 and 2 in which the results of all examinations are summarised.

DISCUSSION

Cessation of Attack.—In a previous article [3] which dealt with the attack by shot-hole borer in the experimental area as a whole, up to November 29th, 1940, it was stated that "if the conditions ruling during the observed period continue, the attack must cease in the third year from pruning." The examinations between October 9th and December 3rd, 1941 were made to test that conclusion.

Between November 29th, 1940 and October 9th, 1941 the average number of galleries per bush increased from 25 to 100 in the lightly plucked plots and from 17 to 83 in the hard plucked plots. But between October 9th and December 3rd, 1941 the figures (Tables 1 and 2) do not give any evidence of a general increase in the average number of galleries per bush in either set of plots. In the light plucked plots the values obtained at the five examinations fluctuated about a mean of 91; in the hard plucked plots the fluctuations were about a mean of 73.4. It would appear that the number of galleries per bush had become stabilised about these numbers. In other other words, no new galleries were formed; so the attack had ceased.

The position is perhaps more clearly shown when the numbers of occupied galleries are studied. By November 29th, 1940, in the light plucked plots, there was an average of 12.6 galleries per bush occu-

pied by beetles, but by October 9th, 1941, there were only 1.6 occupied galleries per bush. The corresponding figures for the hard plucked plots are 8.2 and 2 occupied galleries per bush. On no occasion during the period October 9th to December 3rd, 1941 were more than 2 occupied galleries per bush found in the plots under either treatment. Such falls in the number of occupied galleries indicate a diminution, amounting practically to cessation, of attack.

If, instead of the number of galleries, the beetle population is used as the criterion, Tables 1 and 2 show that by November 29th, 1940 the light plucked bushes contained 87 beetles per bush, whereas between October 9th and December 3rd, 1941 the average content per bush never exceeded 8. The corresponding figures for the hard plucked bushes are 57 and 6. These figures clearly indicate that the beetle population ceased to increase at some time after November 29th, 1940; later, beetles died more rapidly than young were produced, until the population fell to an almost insignificant level by October, 1941, towards the end of the third year from pruning.

That shot-hole borer attack ceases during the third year from pruning is not generally recognised. Possibly that is due to the fact that shot-hole borer in tea is usually demonstrated by the presence of galleries and not by the presence of beetles. A gallery once formed remains, and is recognisable as a gallery even though the entrance may be obscured by healing. Many galleries are empty because when a family of beetles has been raised the gallery is not normally used again for the same purpose. The young females leave and form new galleries for themselves in which to raise their broods. Towards the end of the third year from pruning a tea bush may contain many galleries but few beetles, as already noted. Only a periodic count of the number of galleries or an examination of the gallery contents will show whether the attack has ceased or not. It is the number of beetles within the galleries that will determine the future of the bush as regards further attack. The facts that towards the end of the third year from pruning the total number of galleries in the bushes had ceased to increase, that the number of occupied galleries had decreased markedly, and that the beetle population had fallen to a very low level, all point to cessation of attack.

Course of Attack.—Shot-hole borer attack in the plots began to increase about May, 1940, *i.e.,* nearly 18 months after pruning and continued at a steady rate until November 29th, 1940 when the first period of examinations was completed. It has been shown in the earlier article [3] that during the period May to November, 1940 the number of galleries in the whole area increased at a rate of 10.7 per cent per week compound interest. At that rate the number of galleries is doubled every 6.5 weeks.

The increase of a population, when the rate of growth is constant is usually in accord with the law of compound interest. But the rate of growth may be disturbed by forces which in the aggregate slow down and may finally stop the growth. From the fact that during the 8-week period October 9th to December 3rd, 1941 there was no real increase in the number of galleries — the number found on December 3rd was certainly not double that found on October 9th as would be expected if the rate of 10.7 per cent per week had been maintained — it is apparent that certain forces became operative mainly after November, 1940, and ultimately eliminated the inherent rate of increase. It is probable that such forces developed gradually, and did not become operative suddenly.

TABLE I

Galleries and their Beetle Contents from Light Plucked Bushes

Examination No.	Date	No. of bushes	Type of Gallery				Galls. per bush	Contents of Galleries					Mean Contents	
			Healed	Empty	Occupied	Total		Eggs	Larvae	Pupae	Adults	Total	Per Bush	Per occupied gallery
	1940													
1	Feb. 7	30	20	14	6	40	1·3	1	15	2	6	24	0·8	4·0
2	Feb. 28	30	7	2	3	12	0·4	3	5	—	5	13	0·5	4·3
3	Mar. 19	30	11	4	2	17	0·6	—	—	—	2	2	0·1	1·0
4	Apr. 9	30	13	9	5	27	0·9	6	7	—	5	18	0·6	3·6
5	May 1	30	16	7	13	36	1·2	26	39	9	22	96	3·2	7·4
6	May 23	30	11	3	18	32	1·1	23	21	10	22	76	2·5	4·2
7	June 12	30	16	3	26	45	1·5	24	53	10	51	138	4·6	5·3
8	July 3	30	22	19	69	110	3·7	56	128	28	149	361	11·9	5·2
9	July 24	30	9	21	65	95	3·2	77	199	30	117	423	14·0	6·5
10	Aug. 15	30	17	44	99	160	5·3	174	246	31	141	592	19·6	6·0
11	Sept 5	30	19	44	118	181	6·0	151	314	67	171	703	23·2	6·0
12	Sept. 24	30	38	42	253	333	11·1	305	478	107	512	1,402	46·3	5·5
13	Oct. 16	30	65	157	340	562	18·7	622	1,062	179	548	2,411	79·6	7·1
14	Nov. 6	30	69	184	285	538	17·9	613	734	112	405	1,864	61·5	6·5
15	Nov. 29	30	116	255	377	748	24·9	710	1,161	196	576	2,643	87·3	7·0
	1941													
16	Oct. 9	12	894	293	19	1,206	100·5	13	31	1	19	64	5·3	3·37
17	Oct. 23	9	501	193	3	697	77·4	—	1	1	3	5	0·6	1·67
18	Nov. 5	12	871	229	19	1,119	93·3	11	34	—	19	64	5·3	3·37
19	Nov. 19	12	869	145	8	1,022	85·2	4	11	—	8	23	2·0	2·88
20	Dec. 3	11	971	111	22	1,104	100·4	27	33	1	24	85	7·5	3·86

TABLE 2

Galleries and their Beetle Contents from Hard Plucked Bushes

Examination No.	Date	No. of bushes	Type of Gallery				Galls. per bush	Contents of Galleries					Mean Contents	
			Healed	Empty	Occupied	Total		Eggs	Larvae	Pupae	Adults	Total	Per bush	Per occupied gallery
	1940													
1	Feb. 7	30	11	3	2	16	0·5	4	12	—	2	18	0·6	9·0
2	Feb. 28	30	12	7	1	20	0·7	—	—	—	1	1	0·0	1·0
3	Mar. 19	30	15	11	6	32	1·1	3	—	—	15	18	0·6	3·0
4	Apr. 9	30	17	4	15	36	1·2	40	40	11	23	114	3·8	7·6
5	May 1	30	9	5	4	18	0·6	14	33	2	5	54	1·8	13·5
6	May 23	30	21	3	14	38	1·3	37	30	6	15	88	2·9	6·3
7	June 12	30	25	13	33	71	2·4	62	100	9	46	217	7·2	6·6
8	July 3	30	14	2	18	34	1·1	26	13	2	35	76	2·5	4·2
9	July 24	30	10	9	44	63	2·1	57	114	24	66	261	8·6	5·9
10	Aug. 15	30	12	17	72	101	3·4	167	210	30	109	516	17·0	7·2
11	Sept. 5	30	24	28	86	138	4·6	170	276	47	150	643	21·2	7·5
12	Sept. 24	30	28	61	133	222	7·4	91	235	86	255	667	22·0	5·0
13	Oct. 16	30	35	70	121	226	7.5	202	316	33	151	702	23·2	5·8
14	Nov. 6	30	67	158	149	374	12·5	321	460	94	206	1,081	35·7	7·3
15	Nov. 29	30	110	153	245	508	16·9	492	742	126	367	1,727	57·0	7·1
	1941													
16	Oct. 9	15	816	398	30	1,244	82·9	16	30	—	30	76	5·1	2·53
17	Oct. 23	11	546	162	12	720	65·5	10	18	3	15	46	4·2	3 83
18	Nov. 5	17	1,083	205	4	1,292	76·0	—	—	—	4	4	0·2	1·00
19	Nov. 19	16	1.213	173	14	1,400	87·5	3	32	8	23	66	4·1	4·71
20	Dec. 3	16	782	99	11	892	55·7	18	41	5	22	86	5·4	7·82

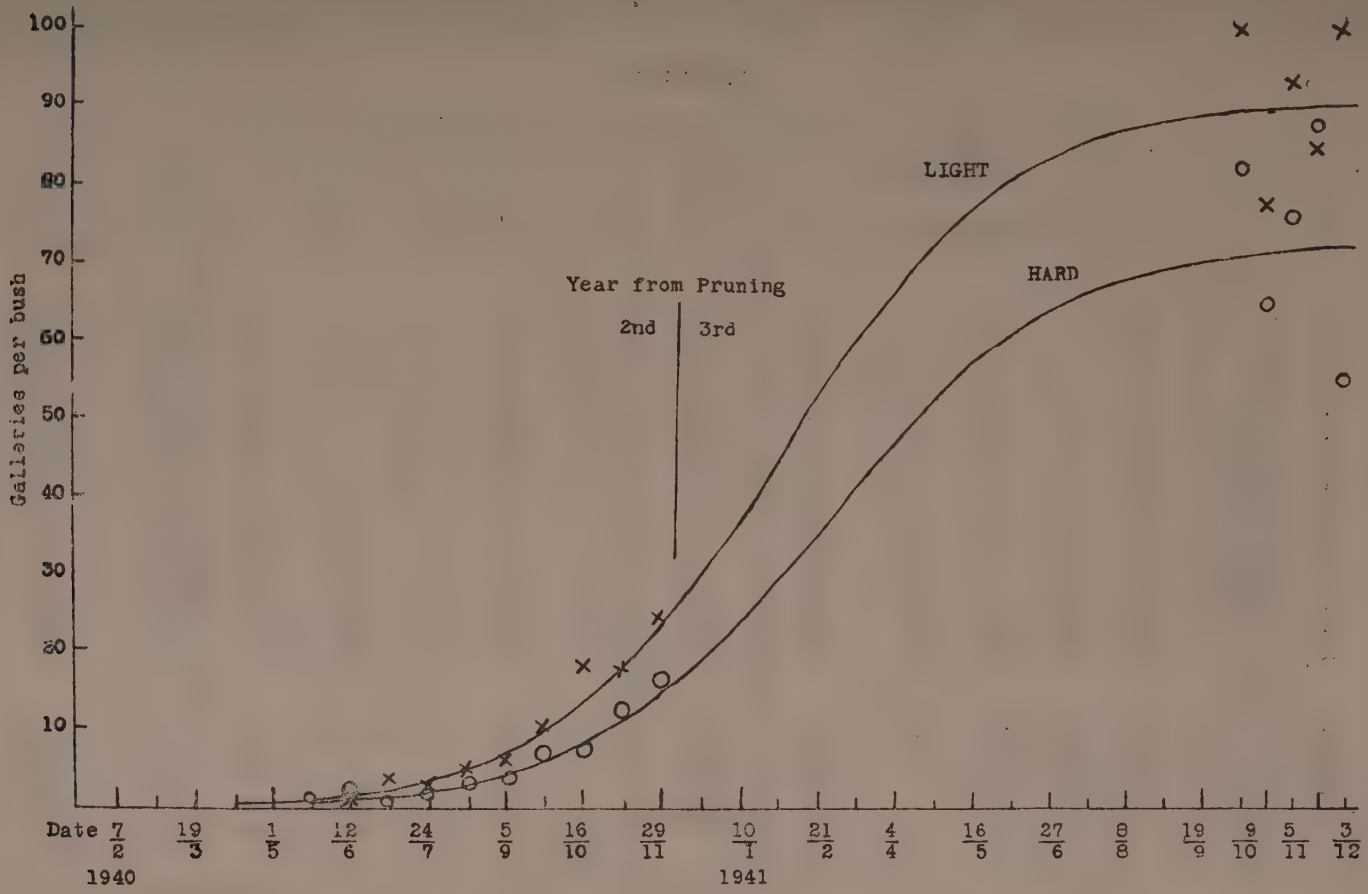

Fig. 1 The number of Shot-hole borer galleries in hard and light plucked tea bushes during the second and third year from pruning.

The course of attack over the whole period is better represented by such curves as are shown in Fig. 1 than by compound interest curves such as were used previously.[3] It should be noted that the data collected over the period ending November, 1940 can be expressed fairly accurately in terms of compound interest, but those terms do not represent in any way the course of attack known to occur later. The curves drawn in Fig. 1 are known to biometricians as "logistic" curves, and they have been calculated (Appendix) from the data given in Tables 1 and 2 by Pearl's method.[6] The observed data from the light plucked plots are represented by small crosses in the figure, and from the hard plucked plots small circles. It will be seen that the curves fairly represent the data from which they have been calculated. Unfortunately no data are available for the period November, 1940 to October 1941, so some doubt must remain that the curves represent accurately the trend in the increase of the number of galleries during that period.

Infestation.—No data are available concerning the increase in the number of galleries in bushes not plucked, so it is not possible to demonstrate directly that plucking has any effect on shot-hole borer attack. In the experimental plots, however, the attack which was increasing during the later half of 1940 terminated towards the end of 1941 owing to the operation of factors, of which plucking may be one. If plucking was not one of those factors, the progress of the attack in both the light and hard plucked plots should have followed a similar course. But it is evident from Fig. 1 that the attack in the light plucked plots was the more severe. At the final examinations, towards the end of 1941, there were, on the average, more galleries in the lightly plucked bushes than in those which had undergone harder plucking. Contrary to planting opinion [5] harder plucking resulted in lighter infestation by shot-hole borer.

In order to compare further the progress of the attack, data for the period August 15th to November 29th, 1940 have been studied in more detail, and a summary of calculations made from Tables 1 and 2, by methods described in a previous article [3] is given in Table 3.

TABLE 3.

Shot-hole borer attack during the period August 15th to November 29th, 1940.

	Type of Pluck	
	Hard	Light
Rate of increase (compound interest) per week in the number of all galleries ..	10.9%	10.6%
Rate of increase per week in occupied galleries	10.9%	7.3%
Rate of increase per week in number of beetles	10.4%	7.3%
Mean content of occupied galleries ...	6.4%	6.6%
Mean time of occupation of galleries ...	9.0—7.1 wks.	8.0—5.0 wks.

From the latter table it will be seen that during this period, before the adverse factors had a very marked effect, the rate of increase in the *total* number of galleries was approximately equal for both types of plucking, but the number of *occupied* galleries increased more rapidly in the light plucked plots, *viz.* 10.9 per cent as compared with 7.3 per cent per week for the hard plucked plots. This suggests that, given equal risks of infestation, the beetles in the hard plucked bushes either abandon more galleries without using them for breeding purposes, or occupy them for a shorter time than is usual in the more lightly plucked bushes. In either case, the beetle population would tend to increase more slowly in the hard plucked bushes and that, ultimately, would result in less damage being done by borers.

It will be seen from Table 3 that the rate of increase in the beetle populations followed closely the rates of increase in the occupied galleries. This was to be expected from the fact that there was little real difference in the mean contents of occupied galleries; under both types of plucking the mean content was about 6.5.

The mean content of galleries gives no indication of the number of individuals raised within the galleries; [2] the length of time galleries are occupied would afford a better measure of the number of beetles likely to emerge. This value cannot be determined with any great accuracy, but by using the method described elsewhere [3] the values for the mean time of occupation of the galleries have been calculated as 7 to 9 weeks in the light plucked and 5 to 8 weeks in the hard plucked bushes, there being a gradual decrease in the mean time of occupation of the galleries by beetles as the bushes increase in age from pruning.

Yields.—During the whole plucking cycle from May, 1930 to September, 1941 1,706 lb. (dry weight) were harvested from the hard plucked plots and 1,363 lb. from the light plucked plots. This represents an increase of 343 lb. or 25 per cent in favour of hard plucking. A statistical examination of the data shows that this difference is very probably real and not due to chance. The weights given above cannot be converted to an acreage basis because of the bushes thrown out of plucking from time to time as they were pruned for borer examinations. Whether hard plucked plots would continue to give the higher yield in later cycles may be open to doubt, but it is not the intention here to discuss the relative merits of the two types of plucking from the point of crop production. It will be sufficient merely to indicate the effect of type of plucking on yields. The increase in yield demonstrated by the hard plucked bushes is to be attributed directly to the type of plucking and not to the diminished shot-hole borer attack.

Physiology.—The majority of species of *Xyleborus* are borers of dead wood, but it is not every piece of dead wood of the right species which is liable to attack. Beeson [1] gives the following conditions as essential for attack: The moisture content should be high, decomposition of cell contents incomplete, invasion by saprophytic wood-destroying fungi scarcely commenced, and in all but a few cases it is necessary that the bark should be present for the initial boring in. The larvae do not feed on wood, but on a fungus, the ambrosia, that grows on the walls of the galleries. The satisfactory feeding of the young therefore depends upon conditions being suitable for the growth of the ambrosia fungus, and the period during

hich the fungus can grow in an assimi-ble form will depend, when dead branches e attacked, on the rate of desiccation of ie wood. *Xyleborus fornicatior,* the tea iot-hole borer, is somewhat exceptional in iat it attacks living branches. Neverthe-ss not every branch is suitable for attack. ranches about half-inch in diameter em to be preferred, but even then, some illeries are deserted shortly after they ave been made.

At present it is impossible to define ie exact conditions which the tea borer nds essential for breeding purposes within tea branch. The texture of the wood by eing too hard or too sappy may cause the eetle to abandon the boring before the llery is complete. A suitable hardness ay satisfy the beetle's own requirements, ut before the gallery becomes ideal for reeding purposes the requirements of the nbrosia fungus have also to be satisfied. uch requirements are likely to include itable water and food conditions.

The continual removal of young aves, by plucking as crop, soon after they e formed must affect many vital processes the bush. Two of the most obvious fects of plucking are the stunting of the ush and the proliferation of branches. The roportion of twiggy branches, not favoured the borer, is increased, but it seems nprobable that the cessation of attack by ie beetle in the third year can be due ntirely, or even largely, to a deficiency of anches of the required thickness. What more likely is that plucking results in a umber of changes within the bush itself hich in the aggregate make the bush un-itable for borer attack. What these anges may be are unknown, but it seems obable that a better knowledge of the ysiology of the tea bush would throw nsiderable light upon the more intimate lationship of the borer with its host.

SUMMARY

An experiment to determine the effects of hard and light plucking on the incidence of shot-hole borer is described. The hard plucked bushes were less severely attacked than the more lightly plucked bushes as shown both by the number of galleries formed and by the smaller beetle population within the lightly plucked bushes.

The attack was most severe during the second year from pruning; later, the attack diminished and was ultimately reduced to negligible proportions. The forces which led to the cessation of attack developed mainly during the third year from pruning and it is suggested that at least some of those adverse factors are intimately connected with the effect of plucking on the physiological processes of the bush.

Logistic curves which illustrate the course of the attacks have been calculated.

ACKNOWLEDGMENTS

The experiment was originally designed by Mr. C. B. Redman King; the writer had charge of it from 13th February, 1941. The data were collected by Messrs. G. D. Austin and W. T. Fonseka at the Passara Sub-Station. We also acknowledge with thanks the facilities afforded by the Management, Nayabedde Estates Co., Ltd., at Gonakelle Estate, Passara; Superintendent Mr. G. Kent Deaker.

APPENDIX

The simple, symmetrical logistic curve is represented by the equation

$$y = \frac{K}{1+Ce^{rt}}$$

where y denotes population and K,C, and r are constants. K is the distance between the upper and lower asymptote; C is a constant of integration; e=2.7183; r is the

inherent rate of growth of the population, and t is the time interval, in this instance in weeks with February 7th, 1940 as the zero time.

The upper asymptotes have been taken as the mean numbers of galleries for the period October to December, 1941, viz., 91 for the light plucked and 73.5 for the hard plucked plots. The lower asymptote is 0.

The curves given in Fig. 1 are represented by the equations

$$y \text{ (light plucked)} = \frac{91}{1 + 337.3e^{-.1142t}}$$

$$y \text{ (hard plucked)} = \frac{73.5}{1 + 387e^{-.1101t}}$$

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THE FOOD POSITION

[Text of a talk given by Dr. W. R. Aykroyd, M.D., Sc.D., Director of the Nutrition Research Laboratories, Coonoor at a meeting of the Nilgiri Planters' Association, South India.]*

The diet of countries which normally import a large proportion of their food supply is naturally subject to great alteration in times of war. England is such a country and the war has led to far-reaching changes in the national diet. I do not propose to discuss in detail war-time food problems in England and the hitherto successful efforts of the authorities to maintain the population in a good state of nutrition. I shall however refer here and there to measures taken in England which are of interest in connection with the situation in India.

In comparison with many other countries India is a self-contained country as regards her food supply. Both imports and exports are small in relation to indigenous food production. The most important food import is, or rather was Burma rice. Imports of other grains are negligible. There is in normal times a small import of expensive products, such as tinned and cold-storage foods, but the use of these is confined to a small section of the population

* Reprinted from "The Planters' Chronicle."

and they may be disregarded in considering the situation as a whole. Some of us miss certain luxuries, which are in short supply at the moment, but we can manage perfectly well without them. One or two imported foods, *e.g.,* dried milk powder and cod liver oil, are of importance from the standpoint of nutrition, but of no quantitative significance.

Rice imports during the last ten years have ranged from 1.1 to 2.6 million tons annually. In 1939-40 they exceeded 2 million tons. Of the total quantity imported, 92 per cent came from Burma, the remainder from Thailand and Indo-China. The total indigenous rice production can be taken as about 29 million tons. Imports in 1939-40 thus amounted to about 6.5 per cent of total rice supplies. Two million tons mean food for about 12 million rice-eaters, reckoning intake at one pound daily.

During the years 1935-40 some 51 per cent of rice imports from Burma, and 93 per cent of imports from Thailand and Indo-China, were cleared through ports in the Madras Presidency. In 1934-40 some 18 per cent of the total rice supply of the Presidency consisted of imported grain. The average percentage for the last ten years may be reckoned as 10-14. Shortage of rice resulting from the cutting off of imports will thus be more keenly felt in the Madras Presidency than elsewhere in India.

Exports.—The loss of imports has not been made up by restriction of exports. Exports previous to the war were small, so that any loss of overseas markets could have little effect. Actually the quantity of grain required for export has been considerably increased as a result of the war. Wheat has to be sent overseas to feed armies and civil populations. Ceylon, cut off like India, from supplies of Burma rice, has to be provided with food. The population of Ceylon (6 millions) is only 1.5 per cent of the population of India and she presumably can obtain part of the food supplies from home-grown crops and accumulated stocks. Nevertheless, the requirements of Ceylon will add appreciably to the rice shortage.

Increased Internal Requirements.—There is another factor to be taken into consideration. Industry is booming, and wage levels have arisen and the number of workers employed in industry has increased. This means that certain sections of the population can afford to consume *more* food than before the war. It has been repeatedly found in diet-surveys that low-paid industrial and urban workers generally have a calorie intake below normal requirements. Any increase in real income will increase their consumption. Men in military service require and obtain more food than they did previous to enlistment. Orr & Lubbock.[1] discussing war-time food resources in Great Britain, make the following comment :—

"It must be remembered in planning our food supply that there will be an increase in gross requirement for food. Men in the fighting forces need about 4,000 calories per day, an increase of between 25 and 30 per cent over the requirements of men in peace-time occupations. Before the war has finished we may have between three and four million men under arms. There will also be a larger number of men employed in the heavy industries. The food requirement of every man who was formerly unemployed will be increased by 30 per cent or more. Hence the total national energy requirement will be increased by between 5 and 10 per cent.

"In India the percentage increase in the 'total national energy requirement' will naturally be of a much smaller order, but by no means negligible."

1.—Feeding the People in War-time, (Macmillan, 1940).

Lack of Margin of Safety.—Even in normal times the food supply of India plus imports does not cover requirements in the sense that the population is abundantly or satisfactorily fed. The diet of large sections is deficient in quality and quantity and below generally accepted standards of adequacy. Because of the existing bare minimum level of diet, there is little 'margin of safety' to allow for further restriction. Some years ago (1937) the author attempted to calculate the total food production of the Madras Presidency and compare it with food requirements. While the investigation was difficult and on the whole unsatisfactory, owing to the absence of adequate statistical data, it provided an indication of the state of affairs. It was calculated that the total food available, including imports, was just sufficient to cover total calorie requirements, reckoned on the basis of 2,500 calories per consumption unit daily, provided it was evenly distributed. The conclusion was as follows: "It seems clear that there is no excess of supply over requirements, and that the imports of rice and other food are necessary to supplement internal production." The above conclusions as regards "lack of margin" can be applied to the whole of India.

More Food Needed.—India is thus short of food, and the only way to ease the situation is to produce more food as rapidly as possible. "Enough food" takes precedence over "the right kind of food;" calories over proteins and vitamins. When increase in the total supply of calories, the solid bulk of food, is the primary and most important consideration, attention must be given to any *crop* which gives a large and rapid return irrespective of its nutritive value and the habitual preferences of the population. When there is a real food shortage, people will not spurn unfamiliar food. A few examples may be given in illustration. Tapioca is of low nutritive value because of its low protein content and in normal times the replacement of rice or other cereals by tapioca is most undesirable. Tapioca, however, gives a large and rapid return — an acre under tapioca will yield two to four times as many calories as an acre under rice or wheat — and it is a dry crop. In the circumstances the extension of tapioca production in suitable areas would be justified. Maize, when consumed as the main ingredient in the diet, may lead to the disease pellagra because of some defect in its chemical composition. It is, however, a highly productive cereal and if its cultivation can be rapidly increased its qualitative defects should be overlooked. The millets—bajra, jowar, Italian millet, etc. — are usually considered inferior as foods to wheat and rice Actually their nutritive value, in comparison with that of other cereal grains, is in general satisfactory. If they can be produced in greater quantities, they can replace equivalent quantities of wheat and rice without disadvantage from the standpoint of nutrition. In certain parts of the Northern Circars the consumption of millets in place of highly-milled rice has had a good effect on health. Owing to the high price of the latter the poorest classes are eating one meal of millet daily. As a result the incidence of acute beriberi in adults and infants has fallen.

Potatoes.—Orr & Lubbock *(loc. cit.)* make the following comment about the potato, with reference to war-time food problems in Great Britain :—

"The potato is of special value for health. An acre of potatoes gives twice as much food as an acre of wheat. It is the surest first crop off ploughed-up old pasture. *The potato is the best insurance crop*

against food shortage. Potatoes should be subsidised for increased consumption."

The potato is one of the staple foods of the British army. Unfortunately the areas in which it can be cultivated in South India are limited and there are likely to be very serious difficulties about fertilisers. But the sweet potato thrives in tropical climate. This root is of considerable value as a supplement to ill-balanced rice diets and its cultivation could be extended with advantage. The production of yams could also be increased.

Vegetables.—During the war a great and successful effort has been made in Great Britain to increase the production of vegetables. Gardens, allotments, golf links plots of waste ground generally have been made to yield their quota. A carefully planned scheme to ensure a steady supply of vegetables from small plots throughout the year was drawn up by the Ministry of Agriculture. Gardens of about 15 × 20 yards in area are producing the following quantities of vegetables in the different seasons :—

	Gross Weight
Spring ...	17 lbs.
Summer ...	19 „
Autumn ...	19 „
Winter ...	26 „

The possibility of increasing the production of vegetables in India by such means is obviously much smaller, but something could be done in this direction. Boarding schools and other institutions receiving government grants can be compelled to create vegetable gardens, or extend gardens already in existence. Institutions already producing vegetables for their own use, such as jails, can increase output by 100 per cent. Owners of suitable compounds can be encouraged or compelled to grow vegetables. The production of vegetables by people of standing has a good psychological effect. I understand that H. E. the Viceroy has given the order that some of the grounds of the Viceregal House in Delhi should be devoted to growing vegetables and that H. E. the Governor of Madras has done the same with regard to grounds of Government House in Ooty. No doubt there would be difficulties in supplying enough seed for a wide-spread and rapid extension of vegetable growing and any increase in production immediately feasible would amount to only a tiny fraction of the additional food required. Garden vegetables are in general foods of low calorie content, and do not add very materially to the energy value of diets. They are, however, a good source of certain vitamins and of value as "health-giving" foods.

More Food from Cereal Grains.—In England the use of wheat flour of 85 per cent extraction has recently been made compulsory, *i.e.,* the population is to be fed on brown instead of white bread. The effect of this is to increase the nutritive value of the staple food of the country, but at the same time to reduce the amount of food for livestock available and hence supplies of milk, meat and eggs Shipping space will be saved by importing less wheat, the reduced quantity available being made to supply an amount of human food equivalent to that supplied by the previous larger imports. A given quantity of grain or grain product fed directly to human beings supplies much more energy (calories) than the same amount of grain fed through animals and returned as meat, dairy products, or eggs. The effect of the change, as has been pointed out, will be to reduce supplies of these foods, but presumably it is hoped that the improvement

in the nutritive value of the staple cereal will make up for losses in other directions.

In India the position as regards wheat is quite different. The great bulk of the wheat crop is stone-ground in village homes and small mills, and consumed whole or nearly so. The production of refined wheat flour (maida) in roller mills amounts to only 400,000 tons, or approximately 4.5 per cent of the total wheat supply. Clearly prohibiting the manufacture of white flour would have a negligible effect on the quantities of wheat products available for human consumption.

Rice.—Some 27 per cent of the total paddy crop is machine-milled, the remainder being prepared for consumption by hand-pounding. The total quantity of machine-milled rice produced amounts to about seven million tons. Hand-pounding removes the germ and a proportion of the pericarp; home-pounded rice is not equivalent to husked whole rice with all the integuments of the grain intact. Taking home-pounded rice as the standard, what would be the effect if all the rice produced in India were consumed in the same state? A given weight of paddy would yield about 6 per cent more rice for consumption. If all paddy were home-pounded, or milled only to the same degree as home-pounded rice, an additional 420,000 tons of rice or thereabouts, amounting to about 1.6 per cent of total rice supplies, would become available.

It would be reasonable to encourage the use of home-pounded rice as a method of extending available food supplies. People used to consuming highly-milled rice are, however, usually very loath to change over to under-milled rice, and even if by some miracle of propaganda the change could be rapidly brought about, it would not greatly influence the situation as regards total supplies of rice. The same is true of any compulsory measure prohibiting the milling of rice beyond a certain degree.

Similar problems do not arise in the case of the *millets*, which are not subjected to milling processes which remove the most valuable parts of the grain.

Food Production and Requirements.—I do not propose to discuss transport difficulties, the hoarding of stocks, commercial brigandage and how each is responsible for producing the present situation. At the moment the commercial aspect is most prominent. The people are firmly convinced that the high price of foodstuffs and short retail supplies are the result of the villainy of middlemen. Much could be done to control the prices of available food supplies, to arrange for necessary transport and ensure their equitable distribution. These are matters for vigorous government action. It is the commercial and railway transport aspects of the food situation which are most prominent in the mind of the government official. But we must avoid the idea that the solution of the problem is entirely a matter of price regulation and so on, that all would be well if a few profiteers were dealt with according to their deserts and the remainder intimidated by the wholesome example. Behind the commercial ramp there is, or will be, in all probability, a real shortage of food. At present it is very difficult to estimate how serious the shortage is. We have figures for rice production in normal pre-war years and for purposes of calculation it might be assumed that production in future will be of the same order. Theoretically it might be possible to compare such an estimate of production with the calculated requirements of South India. But the existing figures are scarcely accurate enough to justify such a method of

approach. Another difficulty is that we have no precise knowledge as to the proportion of the population which consumes rice. This is not a constant proportion, since many groups which in general prefer to eat rice when its price is low will turn to millets when the price of rice is high. Again, there is no real information as to the existing stocks of rice and other grains — a point of essential importance. We have however the undeniable facts that for a number of years India has been importing Burma rice in fairly large quantities and that this food came into the country because it was needed. Imports are now stopped. It is, therefore, safer to assume that there is, or will be, a genuine shortage of food, perhaps not of very formidable proportions, but still a shortage, and take steps accordingly.

MINUTES OF MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD 16-4-42

Minutes of a Meeting of the Board of the Tea Research Institute of Ceylon held at the Ceylon Chamber of Commerce Rooms, Colombo, on Thursday, April 16th, 1942, at 2-30 p.m.

Present.—The Hon'ble the Financial Secretary (Mr. H. J. Huxham), the Director of Agriculture (Mr. E. Rodrigo), the Chairman, Planters' Association of Ceylon (Mr. D. E. Hamilton), the Chairman, Ceylon Estates Proprietary Association (Mr. H. Bois), Messrs. R. G. Coombe, J. D. Hoare, J. C. Kelly, W. H. Gourlay, G. K. Newton, W. P. H. Dias and Dr. R. V. Norris (Director and Secretary).

In the unavoidable absence of the Chairman through illness Mr. J. C. Kelly was unanimously elected as Chairman of the Meeting on the proposal of Mr. Hamilton, seconded by Mr. Newton.

1. The Notice convening the Meeting was read.

The Chairman referred to Mr. Panabokke's indisposition which he hoped would be of a temporary nature only.

2. The Minutes of the Meeting of the Board held on the 26th February, 1942, were confirmed.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES

There were no changes to report

4. FINANCE

(a). Audited Accounts for 1941.

The T. R. I. Audited Accounts for 1941 had been issued to members and the Chairman reported that these with the accounts of the Junior Staff Provident and Medical Funds had been considered by the Finance Committee with the Auditors' Reports thereon. The Auditors' Reports were of the usual satisfactory nature reflecting credit

on the Director, Superintendent and their staffs. No particular comment seemed to be called for

The audited accounts were unanimously accepted by the Board and recorded.

(b). T. R. I. Accounts for February. 1942 which had been issued to members were accepted and recorded.

(c). In view of the difficulty in cashing cheques locally for cash payment, the Director was authorised to open an account at the National Bank of India, Nuwara Eliya.

5. ST. COOMBS ESTATE

(a). Visiting Agent's Report dated 7th March, 1942

Comment on this was deferred pending its consideration by the Estate and Experimental Sub-Committee.

(b). Rationing.

Reported that the Institute was following the proposals laid down in C. E. P A. Circular No. 93 dated 31st March.

After discussion, it was agreed that in view of possible changes in the food position from time to time the Director and Superintendent be given discretion to vary rationing arrangements as required to conform with district practice.

(c) Tea for the United Kingdom Government.

In view of the request by the Tea Commissioner for further supplies of tea for the U. K. Government the Director was authorised to tender a further 5 per cent of the anticipated crop in addition to the 125,200 lb. already tendered.

6. DIRECTORSHIP OF THE INSTITUTE

Reported that the Director's present agreement would expire in 1943 and the Director would be due to proceed on leave in January, 1943 prior to retirement. It was therefore necessary to decide what action should be taken. Extracts from Board Minutes of October 10th, 1936, relating to the Director's present agreement were read to the Board.

The Director then retired from the meeting while the matter was discussed. On his return, the Chairman informed Dr. Norris that very appreciative references to his work had been made by members of the Board and the Board had unanimously agreed to offer him a further renewal of his agreement for a period of five years from the expiry of the present agreement.

Dr. Norris in accepting this renewal expressed his appreciation of the Board's action.

7. FOOD PRODUCTION

The Director reported that effect was being given to the resolution of the Board in relation to utilisation of Tea Research Institute Staff for Food Production work on estates. Local Food Committees were being set up in each district to which officers of the research institutes would be attached for advisory purposes.

The Director of Agriculture referring to the seed position said delivery had been delayed by shipping difficulties but supplies of several varieties of seed were available. He agreed to issue periodical notices to the press in regard to seeds that might be available.

8. ANY OTHER BUSINESS

It was recorded that the Draft Report of the Board for 1941 had been approved by Circulation of Papers (Circular No. A/7/42 dated 24th March, 1942.)

ROLAND V. NORRIS,
Secretary.

NOTICES

The Institute's Laboratories and Offices re situated at St. Coombs, Talawakelle, nd all applications and enquiries should e addressed to the Director, Tea Research nstitute, St. Coombs, Talawakelle.

Specimens and other consignments ent by rail should be forwarded to Tala-akelle Station c/o Messrs. M. Y. Hema-handra & Co., Forwarding Agents. *arriage should be pre-paid.*

Visitors' Days.—The *second* and *last* Vednesdays in each month have been set side as Visitors' Days at St. Coombs Estate. nd also at the T. R. I. Sub-Station, Gona-elle Estate, Passara, when it is hoped any-he interested will visit the Stations.

Visitors at other times are welcomed, ut it is requested that an appointment be nade if possible.

RULES FOR THE OCCUPATION OF ST. COOMBS GUEST HOUSE

(1). The Guest House is normally intended for the use of persons visiting the Institute and St. Coombs Estate on business. Children can in no circumstances be accommodated.

(2). Permission to occupy a room for the night must be obtained from the Director in writing and, unless sufficient notice be given, accommodation cannot be guaranteed. Two double rooms are available for the use of visitors accompanied by their wives.

(3). All visitors must sign the Visitors' Book on arrival.

(4). A bedroom may not be occupied for more than one night if required by another visitor. This shall not apply to Members of the Board or of Committees meeting at St. Coombs who shall also be entitled to priority in the allocation of accommodation when on official business.

(5). Complaints or suggestions shall be entered in the book provided for the purpose and not made to the Guest House Staff. All payments due for services rendered shall be made in *cash* to the steward-in-charge and a receipt obtained from him on the official form. The scale of approved charges is posted in the building. The steward is forbidden to give credit or to accept cheques.

(6). Liquor is supplied for consumption *in the premises only.*

(7). The Institute accepts no responsibility for cash, jewellery or other valuables of any kind left in the Guest House.

(8). All breakages will be charged for at cost price.

ROLAND V. NORRIS,
Director.

The Tea Research Institute of Ceylon.

BOARD OF CONTROL

(A) Representing the Planters' Association of Ceylon:—

(1) Mr. R. G. Coombe

(2) Mr. James Forbes (on leave), Mr. G. K. Newton (acting)

(3) Mr. J. D. Hoare

(B) Representing the Ceylon Estates Proprietary Association:—

(4) Major J. W. Oldfield, C.M.G., O.B.E., M.C.

(5) Mr. W. H. Gourlay.

(6) Mr. J. C. Kelly

(C) Representing the Low-Country Products' Association:—

(7) Mr. W. P. H. Dias

(D) Representing the Small-Holders:—

(8) Mr. T. B. Panabokke, First Adigar (Chairman)

(E) Ex-Officio Members:—

(9) The Hon. the Financial Secretary

(10) The Director of Agriculture

(11) The Chairman, Planters' Association of Ceylon

(12) The Chairman, Ceylon Estates Proprietary Association

Secretary, Roland V. Norris, D.Sc., St. Coombs, Talawakelle.

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The publications of the Tea Research Institute will be sent, free of charge, to Superintendents of Ceylon tea estates, over 10 acres in extent, and to Estate Agencies dealing with Ceylon tea, if they register their names and addresses with *the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle.*

Other persons can obtain the publications of the Institute on application to the Director, the subscription being Rupees fifteen per annum for persons resident in Ceylon or India, and £1-5-0 for those resident elsewhere. Single numbers of *The Tea Quarterly* can be obtained for Rs. 2-50 or 4*s*. In the case of Indian cheques four annas should be added to cover commission.